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ROCKY MOUNTAIN ARSENAL

,enter
Colorado

FINAL PHASE I
CONTAMINATION ASSESSMENT REPORT
SITE 36-12: PITS/TRENCHES
(Version 3.2)

January 1988
Contract Number DAAK11-84-D0016
Task Number 1 (Section 36)

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.

HARDING LAWSON ASSOCIATES   MIDWEST RESEARCH INSTITUTE

PREPARED FOR

US ARMY
AMC

PROGRAM MANAGER'S OFFICE FOR

ROCKY MOUNTAIN ARSENAL CLEANUP

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13. ABSTRACT *(Maximum 200 words)*

THIS FINAL REPORT DOCUMENTS THE PHASE I CONTAMINATION SURVEY OF SITE 36-12, A MUNITIONS STORAGE YARD USED DURING THE EARLY 1950'S.

23 SAMPLES FROM 7 BORINGS WERE ANALYZED FOR VOLATILE AND SEMIVOLATILE ORGANICS AND METALS WITH SEPARATE ANALYSES FOR AS, HG, AND DBCP. CU, CR, AS, HG, PB, AND ZN WERE DETECTED ABOVE THEIR RESPECTIVE INDICATOR RANGES. WITH THE EXCEPTION OF THE SUPERFICIAL SAMPLES CONTAINING HG, THE OTHER METAL CONCENTRATIONS APPEAR TO BE INDICATIVE OF NATURALLY OCCURRING LEVELS.

THE HG CONTAMINATION WILL BE FURTHER INVESTIGATED UNDER THE SECTION 36-UNC SURVEY SINCE THESE VALUES APPEAR TO BE RELATED TO WINDBLOWN CONTAMINATION IN THE NONSOURCE AREAS OF THIS SECTION. A PHASE II PROGRAM IS NOT RECOMMENDED FOR SITE 36-12 SINCE THE EXPECTED ORGANIC COMPOUNDS WERE NOT DETECTED.

APPENDICES: CHEMICAL NAMES, PHASE I CHEMICAL DATA, COMMENTS AND RESPONSES.

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LITIGATION TECHNICAL SUPPORT AND SERVICES
Rocky Mountain Arsenal

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SITE 36-12: PITS/TRENCHES
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January 1988
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Task Number 1 (Section 36)

PREPARED BY

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
Harding Lawson Associates   Midwest Research Institute

PREPARED FOR

U.S. ARMY PROGRAM MANAGER OFFICE FOR ROCKY MOUNTAIN ARSENAL

THE INFORMATION AND CONCLUSIONS PRESENTED IN THIS REPORT REPRESENT THE OFFICIAL POSITION OF THE DEPARTMENT OF THE ARMY UNLESS EXPRESSLY MODIFIED BY A SUBSEQUENT DOCUMENT. THIS REPORT CONSTITUTES THE RELEVANT PORTION OF THE ADMINISTRATIVE RECORD FOR THIS CERCLA OPERABLE UNIT.

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SITE 36-12: PITS/TRENCHES

Site 36-12 occupies approximately 120,000 square feet in the southeast quarter of Section 36 of Rocky Mountain Arsenal. The site, which is divided into three rectangular areas, was investigated under Task 1 in the spring of 1985. Although Site 36-12 was reportedly used for trench disposal activities, historical documentation and personnel interviews indicate that the site was a munitions storage yard. Seven borings were drilled to depths of 5 to 17 feet and yielded 23 soil/bedrock samples.

Target volatile and semivolatile compounds were not detected in any of the Phase I samples. The following metals were detected within or slightly above their indicator range: copper, chromium, arsenic, mercury, lead, and zinc. With the exception of four surficial Phase I samples containing elevated mercury concentrations, these metal values appear to reflect chemical variation between alluvial and bedrock samples.

The surficial mercury values will be further investigated under the Section 36-UNC investigation, since these values appear to be related to windblown contamination in the nonsource areas of the section. A Phase II program is not recommended for this site since the expected organic compounds were not detected. Based on Phase I data, the volume of potentially contaminated soil will be reduced from 44,000 bank cubic yards and included in the Section 36-Nonsource Area volume estimate.

SITE 36-12: PITS/TRENCHES

1.0 PHYSICAL SETTING

1.1 LOCATION

Site 36-12 is composed of three rectangular areas in the southeast corner of Section 36 at Rocky Mountain Arsenal (RMA) (Figure 36-12-1). The three sites are each approximately 1 acre in size and were reportedly used for disposal of solid waste including pesticides.

The areal extent of this site was previously estimated at 120,000 square feet (ft^2) (RMACCPMT, 1984, RIC#84034R01). Based on aerial photograph interpretation, the site boundaries were slightly modified prior to the Phase I program, but the investigated site still covered approximately 120,000 ft^2 (Figure 36-12-1). No physical or visual evidence of disposal activity exists at the site.

1.2 GEOLOGY

The site is situated on Pleistocene alluvium which consists of interbedded silty sand, gravel, and clay partly covered by a thin layer of eolian sand and silt. The alluvial thickness is approximately 9 ft based on lithologic logs from nearby monitor wells (Clark, 1985, RIC#85183R01).

The alluvium is underlain by the Denver Formation which is characterized by bentonite-rich clay/shale and compact lenticular sand horizons. Lithologic variations in the Denver Formation include interbedded siltstone, claystone, sandstone, low-grade coal, lignite, and volcaniclastic material (May, 1982, RIC#82295R01, RMACCPMT, 1983, RIC#83326R01; Anderson et al., 1979; RIC#85214R03; Clark, 1985, RIC#85183R01). Based on the logs of nearby monitor wells, a volcaniclastic unit may be projected beneath Site 36-12 (May et al., 1983, RIC#83299R01). Although this unit may sporadically subcrop in the site area, the bulk of the area is thought to be underlain by a bedrock high composed of claystone.

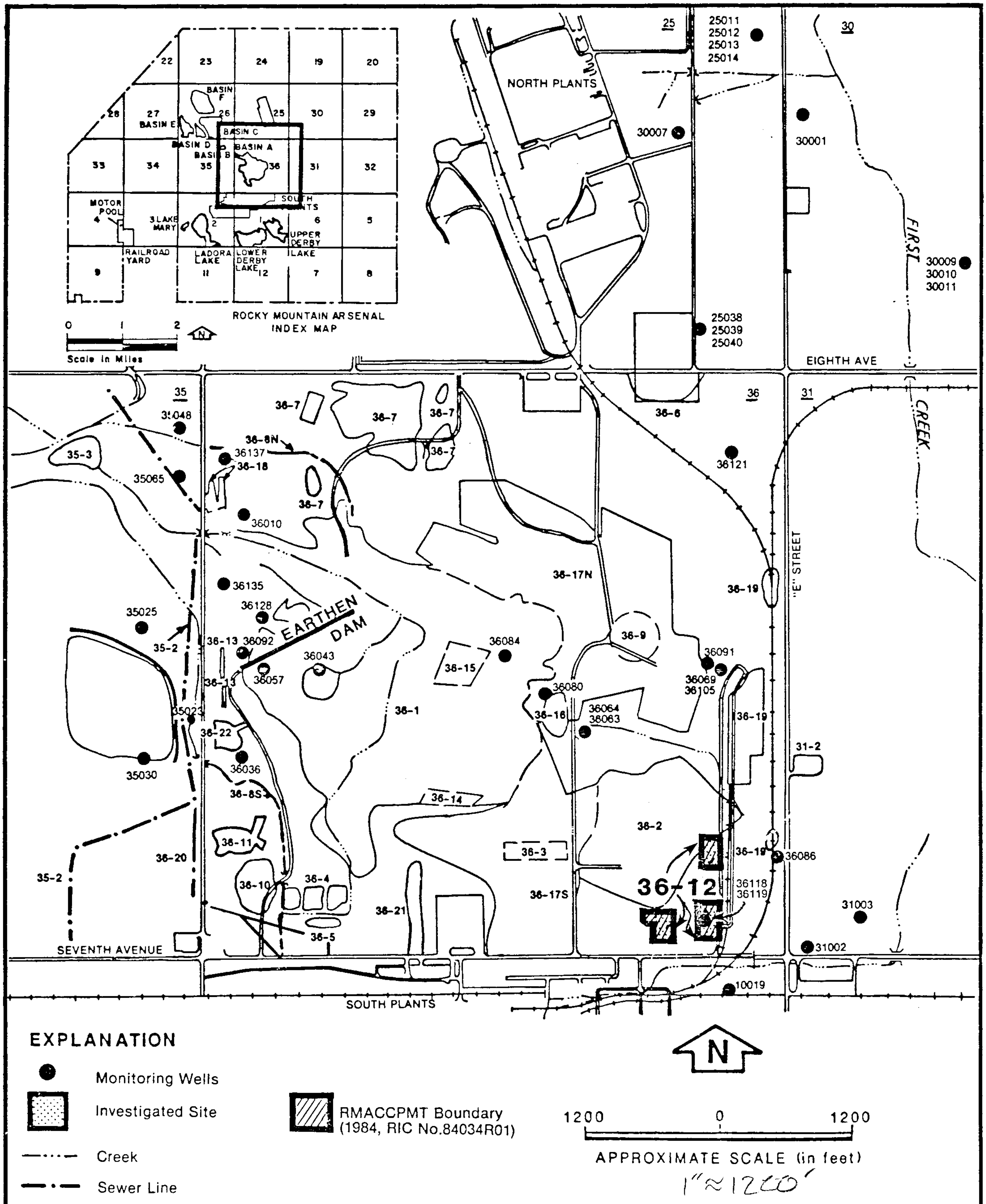

Figure 36-12-1
SITE LOCATION MAP,
SITE 36-12
ROCKY MOUNTAIN ARSENAL
SOURCE: ESE, 1987

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland

The seven Phase I borings investigated the alluvium and the upper portion of the Denver Formation. The alluvium consisted of 3 to 4 feet (ft) of sandy silt underlain by 2 of 4 ft to fine-grained, silty sand.

The Denver Formation was encountered in the following four borings from Site 36-12.

Boring Number	Bedrock Depth (ft)	Lithology
3126	5.0	Claystone
3127	6.0	Claystone
3129	7.0	Claystone
3132	6.4	Weathered Claystone

A representative boring log is presented in Figure 36-12-2.

1.3 HYDROLOGY

The site is situated on a topographic ridge, which forms a divide between drainage to First Creek and Basin A. The ground surface elevation varies from 5,255 ft above mean sea level (msl) in the northern most rectangular site to 5,263 ft msl in the southeast site (Figure 36-12-3). Surface drainage from Site 36-12 is northwest toward Basin A in the west site and toward First Creek in the other two sites.

Although the general direction of ground water flow at RMA is to the north or northwest, ground water flow beneath Site 36-12 is to the northeast (Figure 36-12-4). The ground water contour map generated from water levels in March 1986 (ESE, 1986b, RIC#86238R08) indicates that the water table elevation ranges from 5,237 ft msl to 5,248 ft msl. The water table at this site lies beneath the alluvium-Denver Formation contact at a depth of 10 to 20 ft below the ground surface. None of the Phase I borings encountered ground water.

Denver Formation Wells 36118 and 36119 were sampled during the Task 4 Initial Screening Program (ESE, 1986b, RIC#86238R08) and are located within Site 36-12 boundaries. Neither of the wells contained target compounds. Not enough data is available to determine if activities at this site contribute to ground water contamination.

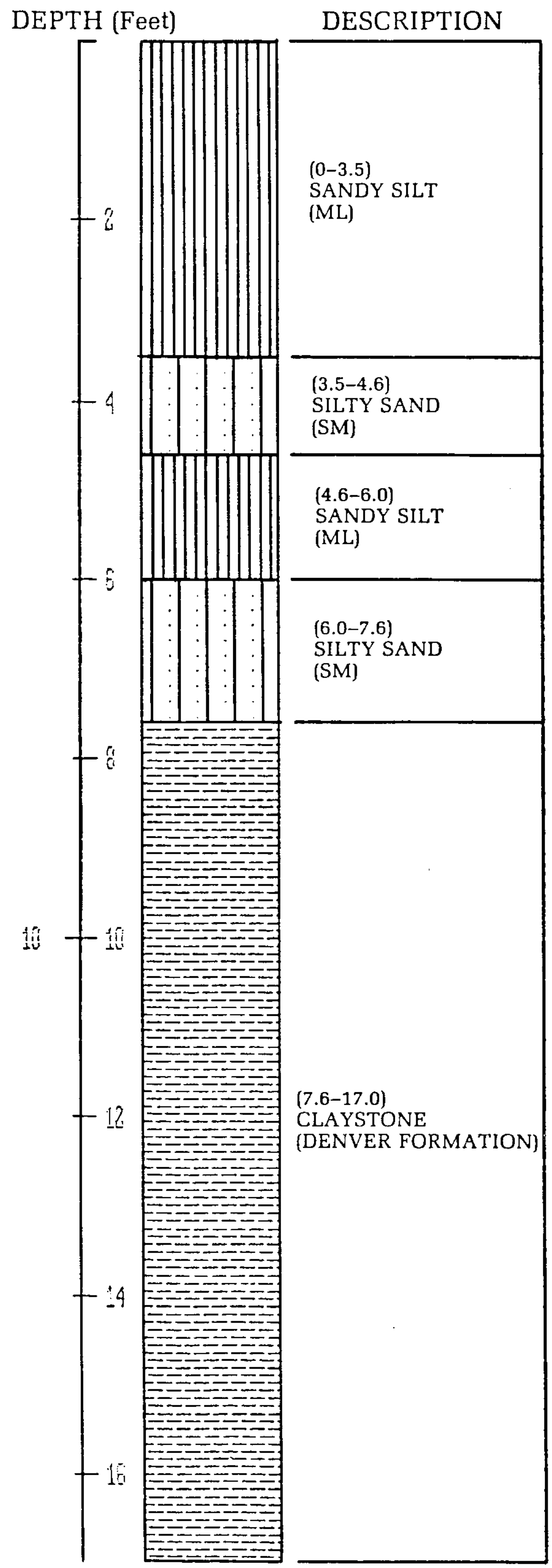

Figure 36-12-2
FIELD BORING PROFILE FOR BORING 3129
SOURCE: ESE, 1987

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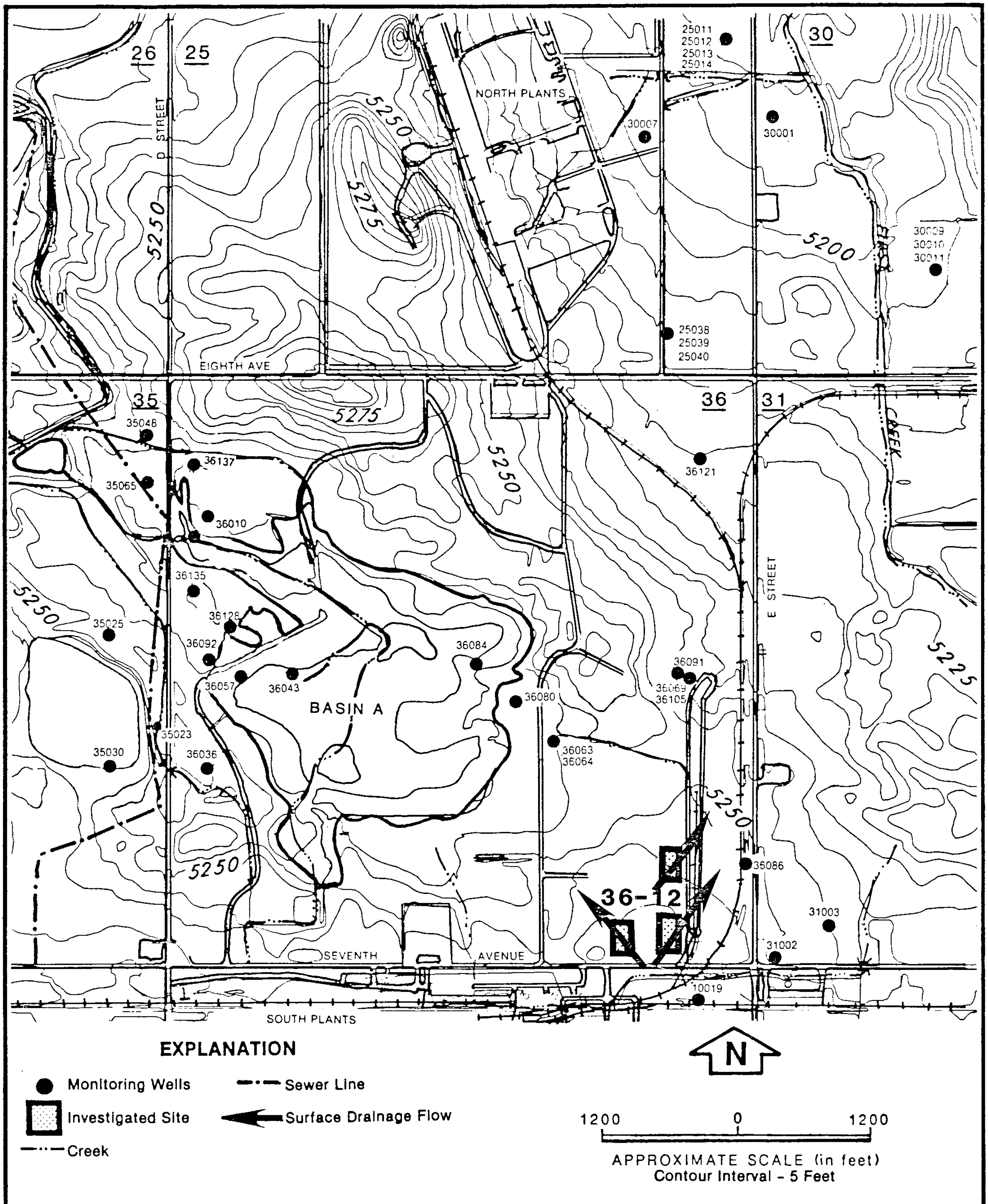

Figure 36-12-3
REGIONAL TOPOGRAPHY,
SITE 36-12
ROCKY MOUNTAIN ARSENAL
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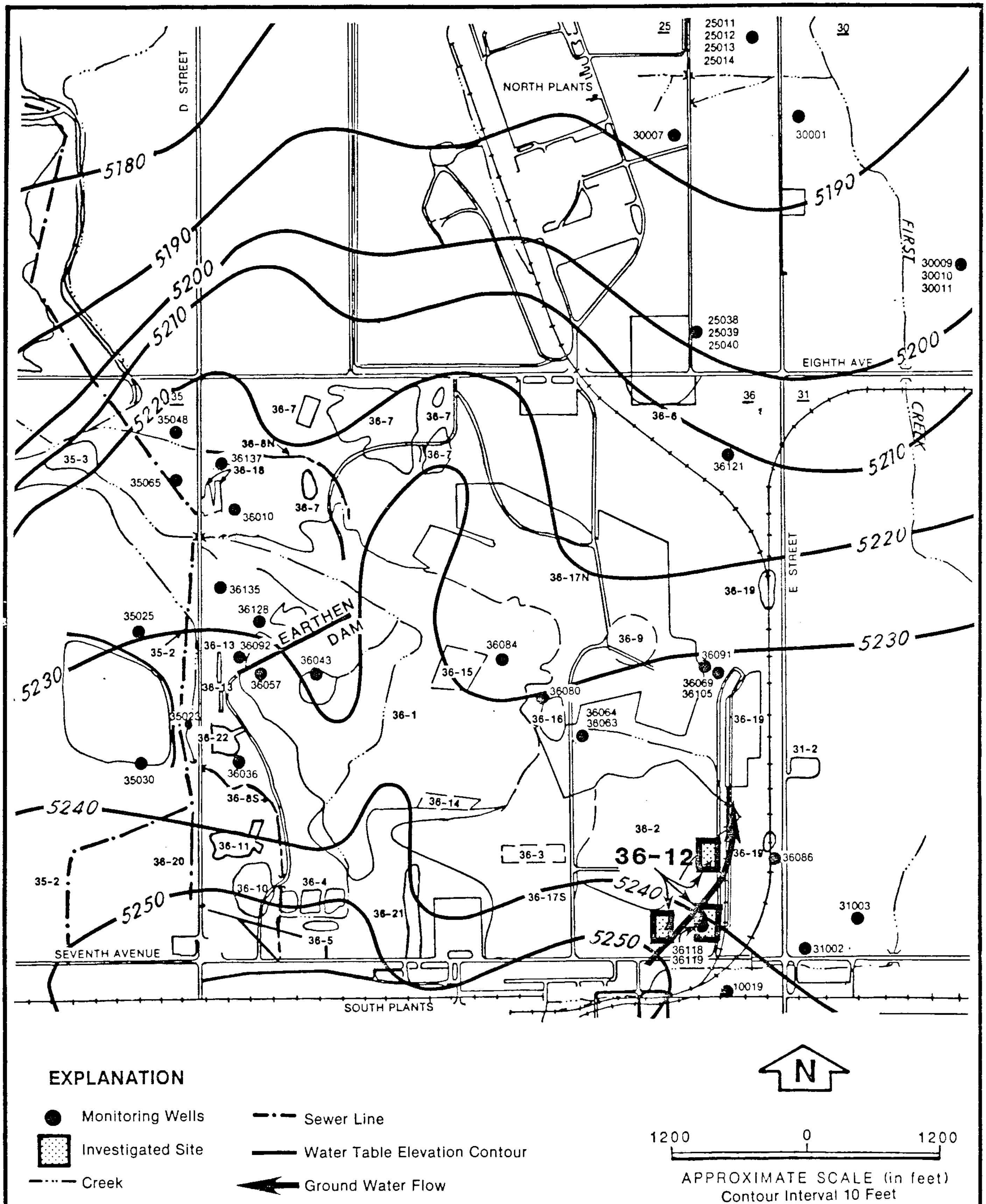

Figure 36-12-4 REGIONAL GROUND WATER FLOW, SITE 36-12 ROCKY MOUNTAIN ARSENAL SOURCE: ESE, 1987	**Prepared for:** **U.S. Army Program Manager's Office For Rocky Mountain Arsenal** **Aberdeen Proving Ground, Maryland**

2.0 HISTORY

During the early 1950's, Site 36-12 contained three rectangular plots which were utilized by the Army for the open storage of M19 clusters (CAPS, 1951; RMA, 1951c; RMA, 1951d). Each plot, with approximate dimensions of 400 ft by 230 ft, contained four tracks, oriented north-south, upon which the munitions were stored (CAPS, 1951; RMA, 1951c). Also during the 1950's, similar plots surrounded Site 36-12. It appears that these neighboring plots carried out the same functions as those in Site 36-12 (CAPS, 1951; RMA, 1951c; RMA, 1951d). A 1951 photograph shows the neighboring plots immediately surrounding Site 36-12 on the west, north, and east.

Three suspected former storage plots are located predominantly within the Site 36-2 firebreak. The first plot, approximately 400 ft west of Site 36-12's northern plot, is a clear rectangular area which displays signs of earlier storage activity. Another clear rectangular plot is approximately 400 ft north. The third suspected plot lies approximately 400 ft north of the northern edge of Site 36-12's northern plot (CAPS, 1951; RMA, 1953).

Three additional plots are east of Site 36-12 within the southeastern region of Section 36-UNC. The first of these storage plots is located west of the GB rail line, approximately 400 ft east of Site 36-12's northern plot and contains four distinct storage rows. The second plot, consisting of one and a quarter rows, is approximately 200 ft from the mid-eastern boundary of Site 36-12. The third plot lies east of the GB rail line, approximately 450 ft east of Site 36-12's southeastern plot. In addition to these plots, a graded area is located approximately 400 ft northeast from Site 36-12's northern plot, and can easily be identified due to extensive grading. This graded area may have contained a storage plot (CAPS, 1951; RMA, 1953).

In August 1950, RMA was reactivated in support of the Korean War. As a result, several munitions programs including the M19 Renovation Program were set into motion at RMA (RMA, 1950b, pp. 103-104).

The M19 Incendiary Cluster is comprised of 38 M69 napalm (NP)-filled bomblets. An M69 weighs 6 pounds, is 19.5 inches long and 2.88 inches wide, and is filled with 2.8 pounds of NP, a "black powder" charge, and magnesium.

In addition, the nose cup houses the charge, a diaphragm, and an M1 delay fuze (Eversman, 1954).

Shipments of M19 cluster bombs from Deseret Chemical Depot to RMA began in November 1950. By the end of March 1951, shipments were completed, and a total of 36,629 clusters had been received for renovation (RMA, 1950b; RMA, 1951b; RMA, 1951c). An unknown number of these cluster bombs were stored in the Site 36-12 area. The crated clusters were probably stacked under tarpaulins at Site 36-12 and neighboring plots for temporary storage (CAPS, 1951; Steidtman, 1951).

By 1953, Site 36-12 and neighboring storage plots were phased out of use, apparently due to (1) the January-March 1951 construction of the GB rail line at which time at least 2,600 M19 clusters had to be removed from the storage plots to make room for the construction in the area, (2) the increased use of Site 36-2, a munition test area, in the immediate vicinity of Site 36-12, (3) the completion of the reworking program in 1952, which led to the shipment of the renovated clusters and/or necessitated the establishment of a permanent storage area at RMA for subsequent storage of the clusters, and (4) the availability of new permanent storage facilities at RMA (CAPS, 1951; Armitage, 1951; RMA, 1951c; RMA, 1951a; Smith, 1951a; RMA, 1950a; RMA, 1953).

Documentation indicates that from approximtely April 1951 to June 1952, the Army reworked a total of 37,657 M19 clusters at RMA (Smith 1951b; RMA, 1952).

A review of aerial photographs taken between 1943 and 1975 (CWS, 1945; CAPS, 1948; CAPS, 1951; RMA, 1953; Stout et al, 1982, RIC#83368R01) reveals the following information pertinent to the Site 36-12 area:

Photograph Date	Site Description
July 9, 1943	No activity at the site can be noticed. The site is indistinguishable from its surroundings.
August 20, 1945	No change from the previous photograph.

October 21, 1948	No change from the previous photograph.
July 21, 1950	No change from the previous photograph.
March 25, 1951	Site 36-12 activity is now visible. Three rectangular plots, each approximately 400 ft by 230 ft, are seen. The two eastern plots contain four north-south-oriented storage rows. The western plot contains three rows and displays signs that an additional row has existed. Neighboring plots surround Site 36-12 on the west, north, and east.
1953	The three rectangular plots at Site 36-12 are faintly visible. It appears that the site is naturally revegetating and is inactive.
February 21, 1958	The site has almost completely revegetated.
August 11, 1962	The site has revegetated and for the most part cannot be distinguished from its surroundings.
October 15, 1975	No changes from the previous photograph.

Site 36-12 was clearly part of a temporary open storage area for M19 incendiary cluster bombs. In February 1982, W.J. Moloney, a RMA employee at the time, prepared a report covering known and suspected disposal activities in Section 36 of RMA. Interpreting a 1953 aerial photograph of RMA, Mr. Moloney reported that the site consisted of "three separate groups, each containing four or five long trenches" (Moloney, 1982, p.7-7). The original site designation, "Pits/Trenches", was based on this photograph interpretation. In a deposition taken in November 1985, however, Mr. Moloney admitted that he had reported this because "I didn't know what it was" and that "it had a suspicious appearance". "In the interest of being careful and conservative, I included it [as a disposal site]", he added. He further clarified that "more than likely what I saw was the storage of munitions" at the site (Moloney, 1985, p. 185).

3.0 SITE INVESTIGATION

3.1 PREVIOUS SOIL INVESTIGATIONS

The soil at Site 36-12 is classified by the U.S. Soil Conservation Service (Sampson and Baber, 1974) in the Ascalon Series and is characterized as Ascalon-Sandy loam with a 3- to 5-percent slope. Ascalon series soils are well-drained and become calcareous with depth. The soil absorbs water at a moderate to rapid rate and has a high water capacity.

No previous soil contamination studies are documented for this site.

3.2 PHASE I SURVEY

3.2.1 Phase I Program

The Phase I Survey for Site 36-12 consisted of drilling 7 borings, yielding 23 soil/bedrock samples from depths from 5 ft to 17 ft. Boring locations are shown in Figure 36-12-5.

Soil samples were collected using the continuous soil sampling method described in the Task 1 Technical Plan (ESE, 1985, RIC#85127R07). Samples were obtained as predetermined intervals unless field conditions (i.e., water table, staining, etc.) required an adjustment in the intervals. Seven borings yielding 23 samples were completed in Site 36-12 as follows:

Boring Number	Depth (ft)	Number of Samples
3126	14.5	4
3127	14.5	4
3128	5	2
3129	17	5
3130	5	2
3131	5	2
3132	15	4
	Total =	23

Prior to drilling, all boring sites were cleared for safety purposes in accordance with the geophysical program detailed in the Task 1 Technical Plan (ESE, 1985, RIC#85127R07). Borehole site clearance was used to ensure drilling would not encounter buried unexploded ordnance (UXO) or other metal that could pose a significant safety risk. Magnetic intensity readings were obtained with a gradiometer. A 20-ft square grid was centered at each boring location and gradiometer readings were obtained at a spacing of 5 ft

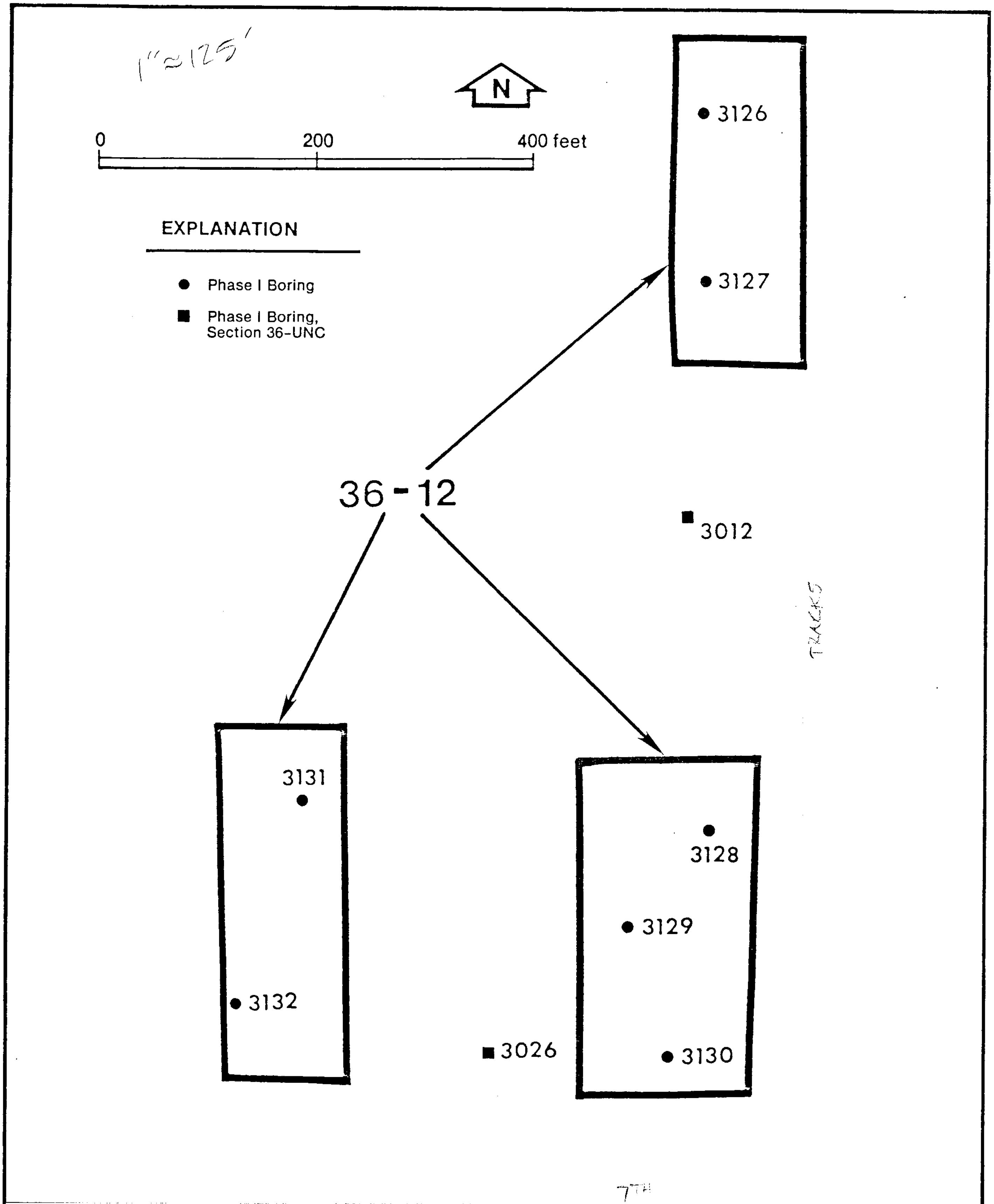

Figure 36-12-5
PHASE I INVESTIGATION
BORING LOCATION MAP
SITE 36-12
SOURCE: ESE, 1987

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland

throughout the area. A contour map was prepared from the data and used to place the boring in the safest location within the geophysical plot. Following borehole site clearance, a metal detector was used to check for surficial (0 to 2 ft) metal which may have presented a safety risk. None of the seven borings were relocated as a result of borehole site clearance, although the gradiometer survey for Boring 3126 indicated a linear anomaly east of the boring which was caused by a barbed wire fence 15 ft away.

A photoionization detector (PID) calibrated to an isobutylene standard, was used to obtain readings from open boreholes during drilling and from soil samples during geologic logging. The PID measures the concentration of organic vapors in the air and is a method of ensuring personnel safety.

All samples were analyzed by gas chromatography/mass spectrometry (GC/MS) for semivolatile organic compounds and by inductively coupled argon plasma (ICP) analyses for cadmium, chromium, copper, lead, and zinc. All samples were analyzed for arsenic and mercury by atomic absorption (AA) spectroscopy and for dibromochloropropane (DBCP) by GC. A GC/MS volatile organic analysis was performed on four samples. A complete list of Phase I analytes is in Appendix 36-12-A.

The Phase I remedial investigation program for this site was developed and implemented based on historical documentation, aerial photographs, and other information available at the time of its implementation. Since that time, previously unavailable information has been identified through the efforts of Acumenics, a contractor to the Department of Justice. This more recently available information has been incorporated into the history section of this report. Furthermore, this additional information has been evaluated in detail to determine how it might impact the investigation approach at this site. Based upon this evaluation, it has been determined that the additional information collected since the Phase I program was designed does not substancially alter the view of potential contamination at this site. As a result, the Phase I program as conducted is judged to provide a complete and accurate investigation of the possible contamination at this site.

3.2.2 Phase I Field Observations

Observations during the drilling operations did not reveal any evidence of historical trenching activities. The ground surface is relatively flat and uniformly vegetated. There are no signs of depressed liner features nor are there any signs of furrows or mounding.

An M8 alarm and M18A2 test kit were used to detect the presence of chemical agents in boreholes and soils samples. The M8 alarm is used to detect Sarin (GB) and VX at detection levels of 0.2 and 0.4 milligrams per cubic meter (mg/m^3) respectively, after a response time of 2 to 3 minutes (USAMDARC, 1982; USAMDARC, 1979; HDOA, 1976). However, many other substances, including smoke and engine exhaust, can activate the M8 alarm. The M18A2 is used as a backup test if the M8 alarm is triggered, as a substitute for the M8, and as a specific check for the presence of mustard (H). Specifically at RMA, the M18A2 test kit is used to detect GB, VX, H, distilled mustard (HD), and Lewisite (L), based upon the knowledge that these agents were manufactured, stored, or demilitarized at the site. The detection limit for mustard agents is 0.5 mg/m^3 and the detection limit for GB is 0.2 mg/m^3. The detection limit for L in soil is 5 parts per million (ppm). Field monitoring for chemical agents with the M8 alarm and M18A2 test kit were negative at this site.

PID readings during drilling were below background in the breathing zone. Readings of 0.4 to 2, however, were observed in the auger annulus.

3.2.3 Geophysical Exploration

Although this site was reportedly used for trench disposal activities, historical documentation, personnel interviews, review of aerial photographs, and field observations indicate that the site was used for munitions storage. No geophysical survey was performed at this site other than the borehole clearance program previously described in Section 3.2.1.

3.2.4 Phase I Analyte Levels and Distribution

Table 36-12-1 contains indicator ranges and a statistical summary of Phase I analytical results. A summary of analytical data for each sample including lithology and air monitoring results is presented in Table 36-12-2. A listing of the target compounds and a tabulation of analytical data can be found in Appendices 36-12-A and 36-12-B.

Table 36-12-1. Summary of Analytical Results for Site 36-12

Constituent	Number of Samples*	Concentrations (μg/g) Range	Mean	Median	ESE Detection Limit	MRI Detection Limit	Indicator Range
Volatiles (N=4)†							
None detected							DL
Semivolatiles (N=23)†							
None detected							DL
Dibromochloropropane (N=23)†							
None detected					0.005	0.005	DL
Metals (N=23)†							
Cadmium	0	--	--	--	0.9	0.5	1.0-2.0
Chromium	13	9-27	14	12	7.2	7.4	25-40
Copper	23	6-47	20	18	4.8	4.9	20-35
Lead	17	19-60	26	22	17	16	25-40
Zinc	23	30-100	57	45	16	2.8	60-80
Arsenic (N=23)†	8	5-10	6.6	6.6	4.7	5.2	DL-10
Mercury (N=23)†	4	0.07-0.16	0.10	0.08	0.050	0.070	DL-0.10

* Number of samples in which constituent was detected above the detection limit.
† N = Number of samples analyzed.
-- Not calculated for less than five detections.
DL Detection limit

Source: ESE, 1987

Table 36-12-2. Concentrations of Target Analytes Above Detection Limits in Site 36-12 Soil Samples (Page 1 of 2)

Bore Number Depth (ft) Geologic Material	3126 0-1 Sandy Silt	3126 4-5 Sandy Silt Fragment of Claystone	3126 9-10 Claystone (Denver Formation)	3126 13.5-14.5 Claystone (Denver Formation)	3127 0-1 Sandy Silt Sandy Clay	3127 4-5 Silty Sand w/ Fragments of Claystone	3127 9-10 Claystone (Denver Formation)	3127 13.4-14.5 Claystone (Denver Formation)	3128 0-1 Sandy Silt	3128 4-5 Silty Sand
AIR MONITORING										
PID*	BKD	BKD	2.0	BKD	BKD	0.4	BKD	2.0	0.6	0.5
SOIL CHEMISTRY										
Volatiles (µg/g)										
	NA	NA	NA	BDL	NA	NA	NA	BDL	NA	NA
Semivolatiles (µg/g)										
None detected										
Dibromochloropropane (µg/g)										
None detected										
Metals (µg/g)										
Cadmium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium	13	BDL	BDL	BDL	24	BDL	BDL	BDL	12	10
Copper	11	26	27	18	16	22	29	37	10	9.0
Lead	31	21	BDL	23	24	20	22	29	BDL	60
Zinc	43	42	38	64	79	61	96	96	42	35
Arsenic (µg/g)	BDL	BDL	BDL	BDL	10	BDL	BDL	6.8	BDL	BDL
Mercury (µg/g)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Table 36-12-2. Concentrations of Target Analytes Above Detection Limits in Site 36-12 Soil Samples (Page 2 of 2)

Bore Number Depth (ft) Geologic Material	3129 0-1 Sandy Silt	3129 4-5 Silty Sand	3129 9-10 Claystone (Denver Formation)	3129 14-15 Claystone (Denver Formation)	3129 16-17 Claystone (Denver Formation)	3130 0-1 Sandy Silt	3130 4-5 Silty Sand	3131 0-1 Sandy Silt	3131 4-5 Silty Sand	3132 0-1 Sandy Silt	3132 4-5 Silty very fine sand	3132 9-10 Claystone (Denver Formation)	3132 14-15 Claystone (Denver Formation)
AIR MONITORING													
PID*	BKD	BKD	BKD	1.4	BKD	BKD	1.4	BKD	BKD	BKD	BKD	1.0	BKD
SOIL CHEMISTRY													
Volatiles (µg/g)													
	NA	NA	NA	NA	BDL	NA	NA	NA	NA	NA	NA	NA	BDL
Semivolatiles (µg/g)													
None detected													
Dibromochloropropane (µg/g)													
None Detected													
Metals (µg/g)													
Cadmium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium	14	9.0	BDL	BDL	BDL	9.0	BDL	12	10	11	10	26	27
Copper	11	6.0	34	39	34	10	9.0	11	21	11	7.0	47	24
Lead	27	BDL	19	26	19	20	BDL	22	BDL	35	BDL	20	20
Zinc	45	30	85	100	86	37	35	40	37	53	35	58	78
Arsenic (µg/g)	6.6	BDL	5.4	6.7	BDL	5.0	BDL	5.8	BDL	BDL	BDL	6.9	BDL
Mercury (µg/g)	0.070	BDL	BDL	BDL	BDL	0.07	BDL	0.10	BDL	0.16	BDL	BDL	BDL

* As calibrated to an isobutylene standard.
BKD No readings above ambient background.
BDL Below detection limit.
NA Not analyzed.

To assess the significance of metal and organic analytical values, indicator ranges were established. For organic compounds, the indicator limit is the method detection limit. For metals, a range of values was chosen to reflect the upper end of the natural range for each metal as normally found in RMA alluvial soil. The procedure for establishing indicator ranges is presented in the Introduction to the Contamination Assessment Reports (ESE, 1986a). Concentrations within and above indicator ranges for Phase I data are presented in Figure 36-12-6.

Semivolatile and volatile target organic compounds were not detected in any of the Phase I samples. Six samples contained arsenic within the indicator range, and one sample (Boring 3127, 0 to 1 ft) had an arsenic concentration slightly above the indicator range. Four of the 0- to 1-ft samples contained mercury within or slightly above its indicator range. Five samples contained lead within its indicator range and one sample (Boring 3128, 4 to 5 ft) contained lead at 60 ppm. Zinc was detected within or above the indicator range in 9 samples and cadmium was not detected in any of the 23 Phase I samples. Nine samples contained copper and two samples contained chromium within their indicator ranges.

Several compounds were detected by GC/MS that were not included in the target compound list and that were not conclusively identified. Table 36-12-3 lists the boring number, sample interval depth, relative retention time (shown as "unknown number" on the table), concentration, sample number, lot best-fit identification, and comments for these nontarget compounds detected at Site 36-12.

It should be noted that an individual compound may have more than one relative retention time and that a particular retention time may be assigned to more than one compound. Therefore, Table 36-12-3 provides only a general indication of additional compounds that may be present.

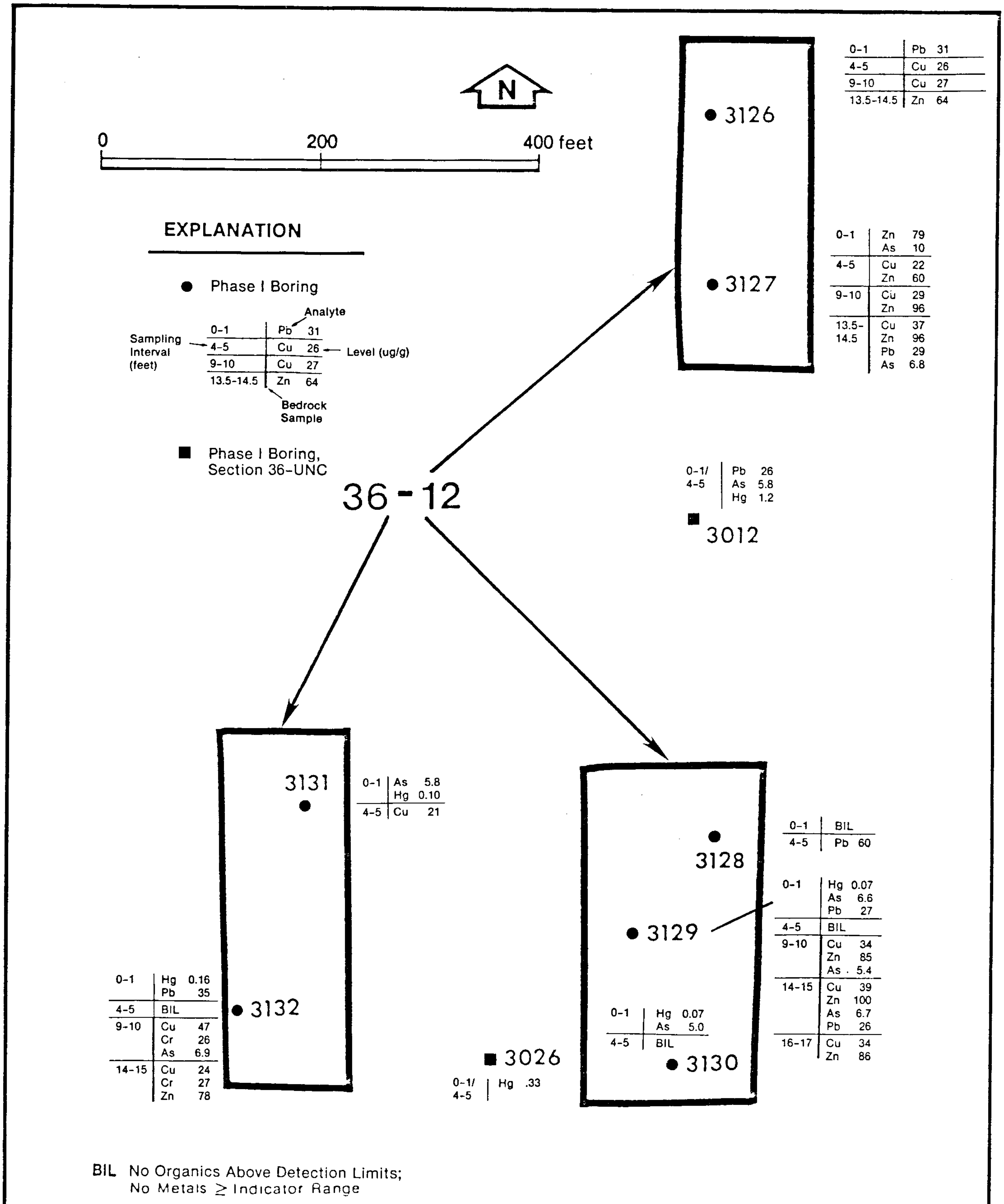

Figure 36-12-6
PHASE I INVESTIGATION
CHEMICAL ANALYSIS RESULTS,
SITE 36-12
SOURCE: ESE, 1987

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland

Table 36-12-3. Tentative Identification of Nontarget Compounds in Site 36-12 Soil Samples. (Page 1 of 2)

Borehole Number	Interval Depth (ft)	Unknown Number	Concentration (ppm)*	Sample Number	Lot	Best Fit	Comments†
3126	0-1	524	0.7	508908	BAT	Oxabicycloheptane	f
	4-5	614	2	508901	BAT	2-(9-Octadecenyloxy)-ethanol	d
		630	1	508901	BAT	Dioctyladipate	c,d
	9-10	614	0.5	508902	BAT	Dibutylnonanedioate	d,f
	13.5-14.5			508903			j
3127	0-1						j
	4-5	614	100	508506	BAK	9-Octadecen-1-ol	d
	9-10	614	3	508907	BAK	Dibutylnonanedioate	d
		630	2	508908	BAK	Dioctyladipate	c,d
	13.5-14.5			508909			j
3128	0-1	629	2	508912	BAK	Dioctyladipate	c,d
	4-5	620	0.8	508913	BAK	Butyloctadecanoate	d,f
		629	1	508913	BAK	Butyloctadecanoate	d
3129	0-1	628	2	508918	BAJ	Butyl myristate	d
		627	0.5	508918	BAJ	1-Heptadecanol	d,f
		633	0.7	508918	BAJ	Eicosane	d,f
		637	0.6	508918	BAJ	Unknown	a
		642	0.4	508918	BAJ	Unknown	a
		558	0.07	508919	BAJ	Unknown	a
		559	0.05	508919	BAJ	Unknown	a
	4-5	619	0.3	508919	BAJ	Butyl-p-toluene sulphonate	e
		635	0.1	508919	BAJ	Phthalate	a,c,f
	9-10	619	1	508920	BAJ	Butyl-p-toluene sulphonate	e
		621	0.3	508920	BAJ	Heptadecanol, acetate	d
		629	2	508920	BAJ	Octadecanoic acid C_4 ester	d
	14-15	608	0.1	508921	BAJ	Hexadecanoic acid	d
		614	0.5	508921	BAJ	Unknown	a
		619	0.3	508921	BAJ	Butyl-p-toluene sulphonate	e
	16-17	628	1	508922	BAK	Butyl myristate	d
		629	1	508922	BAK	Butyl octadecanoate	d

Table 36-12-3. Tentative Identification of Nontarget Compounds in Site 36-12 Soil Samples. (Page 2 of 2)

Borehole Number	Interval Depth (ft)	Unknown Number	Concentration (ppm)*	Sample Number	Lot	Best Fit	Comments†
3130	0-1	608	0.4	508924	BAJ	Dodecanoic acid	d
		619	0.3	508924	BAJ	Butyl-p-toluene sulphonate	e,i
		629	0.7	508924	BAJ	Dioctyladipate	c,g,h
		633	0.2	508924	BAJ	Unknown hydrocarbon	a,c,f,g
	4-5	619	0.3	508925	BAJ	Butyl-p-toluene sulphonate	e
3131	0-1	608	0.5	508930	BAJ	Tetradecanoic acid	d
		619	0.6	508930	BAJ	Butyl myristate	d
		629	2	508930	BAJ	Dioctyladipate	d
		630	0.2	508930	BAJ	Dodecenol	d
		633	0.2	508930	BAJ	Unknown hydrocarbon	a
	4-5	614	0.5	508931	BAJ	Unknown	a
		619	0.2	508931	BAJ	Butyl-p-toluene sulphonate	e
3132	0-1	619	0.2	508936	BAJ	Butyl-p-toluene sulphonate	e
	4-5	619	0.3	508937	BAJ	Butyl-p-toluene sulphonate	e
	9-10	614	0.4	508938	BAJ	Octasulfur	d
		620	0.7	508938	BAJ	Butyl myristate	d
		621	0.3	508938	BAJ	Heptadecanol acetate	d
		629	1	508938	BAJ	Octadecanoic acid, dibutyl ester	d
	14-15	614	0.9	508939	BAJ	Dibutylnonanedioate	d
		619	0.3	508939	BAJ	Butyl-p-toluene sulphonate	e

* Values reported are method blank corrected.
† a. No positive identification.
b. Surfactant.
c. Plasticizer (note: All phthalates and adipates will have this comment).
d. Derived from natural products.
e. Suspected laboratory contaminant.
f. Low concentration.
g. Low frequency of occurrence.
h. Ubiquitous.
i. Possible column bleed.
j. None detected.

contamination could be the result of windblown contamination from Basin A, which exhibits widespread mercury contamination in near-surface soil. The phenomenon will be investigated under the Section 36-UNC program.

The semivolatile GC/MS method applied to all Phase I samples, although not certified for volatile compounds, has been shown capable of detecting tetrachloroethylene, toluene, chlorobenzene, ethylbenzene, and xylene in the nontarget fraction at low recovery levels. The absence of these compounds in the nontarget results for this site is an indication that no contamination is present from these compounds.

Phase I results indicated that the three storage plots included in the Site 36-12 investigation are not sources of contamination. The neighboring storage plots, therefore, are also not considered to be sources of contamination.

The draft version of this report and the proposed Phase II program were reviewed at the onpost MOA meeting on June 3 and 4, 1986. Comments were received from the Colorado Department of Health on May 7, 1986, and from Shell Chemical Company on April 7, 1986. These comments were considered in the preparation of this final report and are presented with responses in Appendix 36-4-C. U.S. Environmental Protection Agency (USEPA) comments are an integral part of the review process and have been previously incorporated into this report.

3.3 PHASE II SURVEY

Phase I investigation did not detect the presence of organic contaminants at this site. Evidence of disturbed soil that would suggest trenching activities was also not observed during the Phase I investigation. The elevated metals concentrations in Phase I samples are most likely due to natural geochemical variability in the Denver Formation. A review of historical documentation, interviews with RMA personnel, and aerial photographs indicates that Site 36-12 and the neighboring storage plots consisted of munitions storage areas and are not contaminant sources.

The presence of mercury contamination was noted in four samples in the vicinity of Site 36-12 suggesting that the source of the mercury is unrelated to any disposal activity at this site. As mercury may have been aerially distributed over the general area, follow-up studies to determine the extent and significance of shallow mercury contamination will be conducted under the Section 36-UNC program. Therefore, no Phase II work is recommended for Site 36-12.

3.4 QUANTITY OF POTENTIALLY CONTAMINATED SOIL

The Decontamination Assessment Report (RMACCPMT, 1984, RIC#84034R01) outlined a hypothetical cleanup strategy for Site 36-12, which consisted of removing 44,000 bank cubic yards (bcy) of soil from the 120,000 ft^2 site. The maximum depth of excavation was estimated at 15 ft. Since only surficial contamination was encountered, the volume will be reduced and included in the Section 36-nonsource area volume estimate.

4.0 REFERENCES

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APPENDIX 36-12-A
CHEMICAL NAMES, METHODS, AND ABBREVIATIONS

APPENDIX 36-12-A
CHEMICAL NAMES, METHODS, AND ABBREVIATIONS

PHASE I ANALYTES AND CERTIFIED METHODS

Analytes/Methods	Synonymous Names and Abbreviations	Standard Abbreviations
VOLATILE ORGANIC COMPOUNDS/GCMS	VOL	VO
1,1-Dichloroethane	1,1-Dichloroethane	11DCLE
1,2-Dichloroethane	1,2-Dichloroethane	12DCLE
1,1,1-Trichloroethane (TCA)	1,1,1-Trichloroethane	111TCE
1,1,2-Trichloroethane	1,1,2-Trichloroethane	112TCE
Benzene	Benzene	C_6H_6
Bicycloheptadiene	Bicycloheptadiene (BCHD)	BCHPD
Carbon tetrachloride	Carbon tetrachloride	CCL_4
Chlorobenzene	Chlorobenzene	CLC_6H_5
Chloroform	Chloroform	$CHCL_3$
Dibromochloropropane	Dibromochloropropane	DBCP
Dicyclopentadiene	Dicyclopentadiene	DCPD
Dimethyldisulfide	Dimethyldisulfide	DMDS
Ethylbenzene	Ethylbenzene	ETC_6H_5
m-Xylene	meta-Xylene	13DMB
Methylene chloride	Methylene chloride	CH_2CL_2
Methylisobutyl ketone	Methylisobutyl ketone	MIBK
o,p-Xylene	ortho- and/or para-Xylene	XYLEN
Tetrachloroethene (PCE)	Tetrachloroethylene	TCLEE
Toluene	Toluene	MEC_6H_5
Trans 1,2-dichloroethene	Trans 1,2-dichloroethylene	12DCE
Trichloroethene (TCE)	Trichloroethylene	TRCLE
SEMIVOLATILE ORGANIC COMPOUNDS/GCMS	EXTRACTABLE ORGANIC COMPOUNDS (EX)	SVO
1,4-Oxathiane	1,4-Oxathiane	OXAT
2,2-Bis (para-chlorophenyl)-1,1-dichloroethane	Dichlorodiphenylethane	PPDDE
2,2-Bis (para-chlorophenyl) 1,1,1-trichloroethane	Dichlorodiphenyltrichloroethane	PPDDT
Aldrin	Aldrin	ALDRN
Atrazine	Atrazine	ATZ
Chlordane	Chlordane	CLDAN
Chlorophenylmethyl sulfide	p-Chlorophenylmethyl sulfide	CPMS
Chlorophenylmethyl sulfoxide	p-Chlorophenylmethyl sulfoxide	CPMSO
Chlorophenylmethyl sulfone	p-Chlorophenylmethyl sulfone	$CPMSO_2$
Dibromochloropropane	Dibromochloropropane	DBCP
Dicyclopentadiene	Dicyclopentadiene	DCPD
Dieldrin	Dieldrin	DLDRN
Diisopropylmethyl phosphonate	Diisopropylmethyl phosphonate	DIMP

APPENDIX 36-12-A
CHEMICAL NAMES, METHODS, AND ABBREVIATIONS

Analytes/Methods	Synonymous Names and Abbreviations	Standard Abbreviations
SEMIVOLATILE ORGANIC COMPOUNDS (CONT)		
Dimethylmethyl phosphonate	Dimethylmethyl phosphonate	DMMP
Dithiane	Dithiane	DITH
Endrin	Endrin	ENDRN
Hexachlorocyclopentadiene	Hexachlorocyclopentadiene (HCPD)	CL_6CP
Isodrin	Isodrin	ISODR
Malathion	Malathion	MLTHN
Parathion	Parathion	PRTHN
Supona	2-Chloro-1(2,4-dichlorophenyl) vinyldiethyl phosphate	SUPONA
Vapona	Vapona	DDVP
METALS/ICP	ICAP	ICP
Cadmium	Cadmium	CD
Chromium	Chromium	CR
Copper	Copper	CU
Lead	Lead	PB
Zinc	Zinc	ZN
SEPARATE ANALYSES		
Arsenic/AA	Arsenic	AS
Mercury/AA	Mercury	HG
Dibromochloropropane/GC	Dibromochloropropane	DBCP

APPENDIX 36-12-A
CHEMICAL NAMES, METHODS, AND ABBREVIATIONS

PHASE II ANALYTES AND CERTIFIED METHODS

Analytes/Methods	Synonymous Names and Abbreviations	Standard Abbreviations
VOLATILE ORGANIC COMPOUNDS/GCMS (Same as Phase I)	VOL	VO
SEMIVOLATILE ORGANIC COMPOUNDS/GCMS (Same as Phase I)	EXTRACTABLE ORGANIC COMPOUNDS (EX)	SVO
VOLATILE HALOCARBON COMPOUNDS/GCCON	PURGEABLE HALOCARBONS (PHC)	VHO
1,1-Dichloroethane	1,1-Dichloroethane	11DCLE
1,2-Dichloroethane	1,2-Dichloroethane	12DCLE
1,1-Dichloroethene	1,1-Dichloroethene	11DCE
1,1,1-Trichloroethane (TCA)	1,1,1-Trichloroethane	111TCE
1,1,2-Trichloroethane	1,1,2-Trichloroethane	112TCE
Carbon tetrachloride	Carbon tetrachloride	CCL_4
Chlorobenzene	Chlorobenzene	CLC_6H_5
Chloroform	Chloroform	$CHCL_3$
Methylene chloride	Methylene chloride	CH_2CL_2
Trans 1,2-dichloroethylene	Trans 1,2-dichloroethene	12DCE
Tetrachloroethene (PCE)	Tetrachloroethylene	TCLEE
Trichloroethene (TCE)	Trichloroethylene	TRCLE
VOLATILE HYDROCARBON COMPOUNDS/GCFID	DCPD	HYDCBN
Bicycloheptadiene	Bicycloheptadiene (BCHD)	BCHPD
Dicyclopentadiene	Dicyclopentadiene	DCPD
Methylisobutyl ketone	Methylisobutyl ketone	MIBK
VOLATILE AROMATIC COMPOUNDS/GCPID	PURGEABLE AROMATICS (PAM)	VAO
Benzene	Benzene	C_6H_6
Ethylbenzene	Ethylbenzene	ETC_6H_5
m-Xylene	meta-Xylene	13DMB
o,p-Xylene	ortho- and/or para-Xylene	XYLEN
Toluene	Toluene	MEC_6H_5
ORGANOCHLORINE PESTICIDES/GCEC		OCP
2,2-Bis (para-chlorophenyl)-1,1-dichloroethane	Dichlorodiphenylethane	PPDDE
2,2-Bis (para-chlorophenyl)-1,1,1-trichloreoethane	Dichlorodiphenyltrichloroethane	PPDDT
Aldrin	Aldrin	ALDRN
Chlordane	Chlordane	CLDAN
Dieldrin	Dieldrin	DLDRN
Endrin	Endrin	ENDRN
Hexachlorocyclopentadiene	Hexachlorocyclopentadiene	CL_6CP
Isodrin	Isodrin	ISODR

APPENDIX 36-12-A
CHEMICAL NAMES, METHODS, AND ABBREVIATIONS

Analytes/Methods	Synonymous Names and Abbreviations	Standard Abbreviations
ORGANOPHOSPHOROUS PESTICIDES/GCNPD	ORGANOPHOSPHOROUS COMPOUNDS (OPC)	OPP
Atrazine	Atrazine	ATZ
Malathion	Malathion	MLTHN
Parathion	Parathion	PRTHN
Supona	2-Chloro-1(2,4-dichlorophenyl) vinyldiethyl phosphate	SUPONA
Vapona	Vapona	DDVP
ORGANOPHOSPHOROUS COMPOUNDS/GCFPD	DIMP	OPC
Diisopropylmethyl phosphonate	Diisopropylmethyl phosphonate	DIMP
Dimethylmethyl phosphonate	Dimethylmethyl phosphonate	DMMP
ORGANOSULPHUR COMPOUNDS/GCFPD		OSC
1,4-Oxathiane	1,4-Oxathiane	OXAT
Benzothiazole	Benzothiazole	BTZ
Chlorophenylmethyl sulfide	p-Chlorophenylmethyl sulfide	CPMS
Chlorophenylmethyl sulfone	p-Chlorophenylmethyl sulfone	$CPMSO_2$
Chlorophenylmethyl sulfoxide	p-Chlorophenylmethyl sulfoxide	CPMSO
Dimethyldisulfide	Dimethyldisulfide	DMDS
Dithiane	Dithiane	DITH
METALS/ICP	ICAP	ICP
Cadmium	Cadmium	CD
Chromium	Chromium	CR
Copper	Copper	CU
Lead	Lead	PB
Zinc	Zinc	ZN
SEPARATE ANALYSES		
Arsenic/AA	Arsenic	AS
Mercury/AA	Mercury	HG
Dibromochloropropane/GC	Dibromochloropropane	DBCP

APPENDIX 36-12-A
CHEMICAL NAMES, METHODS, AND ABBREVIATIONS

Analytes/Methods	Synonymous Names and Abbreviations	Standard Abbreviations
ARMY AGENT DEGRADATION PRODUCTS:		ADP
AGENT PRODUCTS/HPLC	TDGCL	
Chloroacetic Acid	Chloroacetic acid	CLC2A
Thiodiglycol	Thiodiglycol (TDG)	TDGCL
AGENT PRODUCTS/IONCHROM	IMPA	GBDP
Fluoroacetic acid	Fluoroacetic acid	FC2A
Isopropylmethylphosphonic acid	Isopropylmethylphosphonate	IMPA
Methylphosphonic acid	Methylphosphonate	MPA

Methods	Abbreviations
Atomic Absorption Spectroscopy	AA
Gas Chromatography/Conductivity Detector	GCCON
Gas Chromatography/Electron Capture	GCEC
Gas Chromatography/Flame Ionization Detector	GCFID
Gas Chromatography/Flame Photometric	GCFPD
Gas Chromatography/Mass Spectrometry	GCMS
Gas Chromatography/Nitrogen Phosphorous Detector	GCNPD
Gas Chromatography/Photoionizaton Detector	GCPID
High Performance Liquid Chromatography	HPLC
Inductively Coupled Argon Plasma	ICP, ICAP
Ion Chromatography	IONCHROM

APPENDIX 36-12-B
PHASE I CHEMICAL DATA

ENVIRONMENTAL SCIENCE & ENGINEERING 12/03/85 STATUS: PRELIMINARY

PROJECT NUMBER 84936300
FIELD GROUP: 3612A
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

PARAMETERS	STORET # METHOD #	3126A 508900	3126B 508901	3126C 508902	3126D 508903	3127A 508906	3127B 508907	3127C 508908	3127D 508909	3128A 508912	3128B 508913
DATE		05/23/85	05/23/85	05/23/85	05/23/85	05/07/85	05/07/85	05/07/85	05/07/85	05/07/85	05/07/85
TIME		816	823	851	918	950	959	1022	1104	901	908
SAMPLE TYPE	71999 0	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO
SAMPLE DEPTH(CM)	99758 0	0	122	274	411	0	122	274	411	0	122
SITE TYPE 1	99759 0	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
INSTALLATION CODE	99720 0	RK	RK	RK	RK	RK	RK	RK	RK	RK	RK
SAMPLING TECHNIQUE	72005 0	S	S	S	S	S	S	S	S	S	S
MOISTURE(%WET WT)	70320 0	13.4	13.9	19.3	21.9	12.3	19.3	19.2	17.5	8.9	4.1
CADMIUM,SED (UG/G-DRY)	1028 0	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
CR,SOIL (UG/G-DRY)	99584 0	13	<7	<7	<7	24	<7	<7	<7	12	10
COPPER,SED (UG/G-DRY)	1043 0	11	26	27	18	16	22	29	37	10	9
LEAD,SED (UG/G-DRY)	1052 0	31	21	<17	23	24	20	22	29	<17	60
ZINC,SED (UG/G-DRY)	1093 0	43	42	38	64	79	61	96	96	42	35
ARSENIC,SED (UG/G-DRY)	1003 0	*<4.7	*<4.7	*<4.7	*<4.7	10	<4.7	<4.7	6.8	<4.7	<4.7
MERCURY,SED (UG/G-DRY)	71921 0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
ALDRIN,SED (UG/G-DRY)	98356 0	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900
DIELDRIN(UG/G-DRY)	98365 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
DDT,PP'(UG/G-DRY)	98364 0	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400
ENDRIN (UG/G-DRY)	98369 0	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700
CHLORDANE,SED(UG/G-DRY)	98361 0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
DDE,PP'(UG/G-DRY)	98363 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
1,4 OXATHIANE (UG/G-DRY)	98644 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300

ENVIRONMENTAL SCIENCE & ENGINEERING 12/03/85 STATUS: PRELIMINARY

PROJECT NUMBER 84936300
FIELD GROUP: 3612A
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

PARAMETERS	STORET # / METHOD #	3126A 508900	3126B 508901	3126C 508902	3126D 508903	3127A 508906	3127B 508907	3127C 508908	3127D 508909	3128A 508912	3128B 508913
DATE		05/23/85	05/23/85	05/23/85	05/23/85	05/07/85	05/07/85	05/07/85	05/07/85	05/07/85	05/07/85
TIME		816	828	851	918	950	959	1022	1104	901	908
DIMP (UG/G-DRY)	98645 0	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
DICHLORVOS (UG/G-DRY)	98646 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
HEXCLCYYPENDI (UG/G-DRY)	98647 0	<1.00	<1.00	<1.00	<1.00	<0.869	<0.869	<0.869	<0.869	<0.869	<0.869
MALATHION (UG/G-DRY)	98648 0	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600
ISODRIN (UG/G-DRY)	98649 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
1,4 DITHIANE (UG/G-DRY)	98650 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
DICYCLOPENTADIENE (UG/G-DRY)	98651 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
DBCP(NEMAGON) (UG/G-DRY)	98652 0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
P-CLPHENYLMETHYSULFIDE(UG/G-D)	98653 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
P-CLPHENYLMETHYSULFONE(UG/G-D)	98654 0	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400
ATRAZINE (UG/G-DRY)	98655 0	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700
SUPONA (UG/G-DRY)	98656 0	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
DMMP (UG/G-DRY)	98657 0	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
ETY'PARATHION (UG/G-DRY)	98658 0	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700
CARBON TETRACHLORIDE (UG/G-DRY)	98680 0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
CHLOROBENZENE (UG/G-DRY)	98681 0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
CHLOROFORM (UG/G-DRY)	98682 0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
1,1-DICHLOROETHANE (UG/G-DRY)	98683 0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
1,2-DICHLOROETHANE (UG/G-DRY)	98684 0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
BICYCLOHEPTADIENE (UG/G-DRY)	98686 0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA

ENVIRONMENTAL SCIENCE & ENGINEERING 12/03/85 STATUS: PRELIMINARY

PROJECT NUMBER 84936300
FIELD GROUP: 3612A
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

PARAMETERS	STORET #	METHOD #	3126A 508900	3126B 508901	3126C 508902	3126D 508903	3127A 508906	3127B 508907	3127C 508908	3127D 508909	3128A 508912	3128B 508913
DATE			05/23/85	05/23/85	05/23/85	05/23/85	05/07/85	05/07/85	05/07/85	05/07/85	05/07/85	05/07/85
TIME			816	828	851	918	950	959	1022	1104	901	908
TRANS-1,2-DICHLOROET ENE(UG/G-D	98687	0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
ETHYLBENZENE (UG/G-DRY)	98688	0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
METHYLENE CHLORIDE (UG/G-DRY)	98689	0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
TETRACHLOROETHENE (UG/G-DRY)	98690	0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
TOLUENE (UG/G-DRY)	98691	0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
1,1,1-TRICHLOROETHAN E(UG/G-D)	98692	0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
1,1,2-TRICHLOROETHAN E(UG/G-D)	98693	0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
TRICHLOROETHENE (UG/G-DRY)	98694	0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
M-XYLENE (UG/G-DRY)	98695	0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
MIBK (UG/G-DRY)	98696	0	NA	NA	NA	<0.500	NA	NA	NA	<0.500	NA	NA
DMDS (UG/G-DRY)	98697	0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
BENZENE (UG/G-DRY)	98699	0	NA	NA	NA	<0.300	NA	NA	NA	<0.500	NA	NA
O-AND/OR P-XYLENE (UG/G-DRY)	98700	0	NA	NA	NA	<0.500	NA	NA	NA	<0.500	NA	NA
PCPMSO2 UG/G-DRY	98703	0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
COORDINATE,N/S(STP)	98392	0	181573	181573	181573	181573	181421	181421	181421	181421	180918	180918
COORDINATE,E/W(STP)	98393	0	2188182	2188182	2188182	2188182	2188190	2188190	2188190	2188190	2188181	2188181
UNK620 (UG/G)	99074	0										0.819
UNK621 (UG/G)	99075	0										
UNK633 (UG/G)	99085	0										
UNK637 (UG/G)	99089	0										

ENVIRONMENTAL SCIENCE & ENGINEERING 12/03/85 STATUS: PRELIMINARY

PROJECT NUMBER 84936300
FIELD GROUP: 36124
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

PARAMETERS	STORET #	METHOD #	3126A 508900	3126B 508901	3126C 508902	3126D 508903	3127A 508906	3127B 508907	3127C 508908	3127D 508909	3128A 508912	3128B 508913
DATE			05/23/85	05/23/85	05/23/85	05/23/85	05/07/85	05/07/85	05/07/85	05/07/85	05/07/85	05/07/85
TIME			816	828	851	918	950	959	1022	1104	901	908
UNK652 (UG/G)	90108	0										
UNK558 (UG/G)	90098	0										
UNK559 (UG/G)	90099	0										
UNK619 (UG/G)	90105	0										
UNK635 (UG/G)	90087	0										
UNK629 (UG/G)	90082	0									1.65	1.00
UNK608 (UG/G)	90065	0										
UNK614 (UG/G)	90070	0		2.16	0.519			141		2.71		
UNK630 (UG/G)	90106	0		1.03						2.11		
UNK524 (UG/G)	90015	0	0.665									

ENVIRONMENTAL SCIENCE & ENGINEERING 12/03/85 STATUS: PRELIMINARY

PROJECT NUMBER 84936300
FIELD GROUP: 3612A
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

PARAMETERS	STORET # / METHOD #	3129A 508918	3129B 508919	3129C 508920	3129D 508921	3129E 508922	3130A 508924	3130B 508925	3131A 508930	3131B 508931	3132A 508936
DATE		05/06/85	05/06/85	05/06/85	05/06/85	05/07/85	05/06/85	05/06/85	05/06/85	05/06/85	05/06/85
TIME		1437	1442	1504	1546	818	1356	1404	1139	1154	931
SAMPLE TYPE	71999 0	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO
SAMPLE DEPTH(CM)	99758 0	0	122	274	427	488	0	122	0	122	0
SITE TYPE 1	99759 0	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE	BORE
INSTALLATION CODE	99720 0	RK	RK	RK	RK	RK	RK	RK	RK	RK	RK
SAMPLING TECHNIQUE	72005 0	S	S	S	S	S	S	S	S	S	S
MOISTURE(%WET WT)	70320 0	6.0	5.2	15.0	19.0	18.6	4.6	4.3	7.0	1.3	6.0
CADMIUM,SED (UG/G-DRY)	1028 0	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
CR,SOIL (UG/G-DRY)	99584 0	14	9	<7	<7	<7	9	<7	12	10	11
COPPER,SED (UG/G-DRY)	1043 0	11	6	34	39	34	10	9	11	21	11
LEAD,SED (UG/G-DRY)	1052 0	27	<17	19	26	19	20	<17	22	<17	35
ZINC,SED (UG/G-DRY)	1093 0	45	35	85	101	86	37	35	40	37	53
ARSENIC,SED (UG/G-DRY)	1003 0	6.6	<4.7	5.4	6.7	<4.7	5.0	<4.7	5.8	<4.7	<4.7
MERCURY,SED (UG/G-DRY)	71921 0	0.07	<0.05	<0.05	<0.05	<0.05	0.07	<0.05	0.10	<0.05	0.16
ALDRIN,SED (UG/G-DRY)	93356 0	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900	<0.900
DIELDRIN(UG/G-DRY)	93365 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
DDT,PP'(UG/G-DRY)	93364 0	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400
ENDRIN (UG/G-DRY)	93369 0	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700
CHLORDANE,SED(UG/G-DRY)	93361 0	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
DDE,PP'(UG/G-DRY)	93363 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
1,4 OXATHIANE (UG/G-DRY)	93644 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300

ENVIRONMENTAL SCIENCE & ENGINEERING 12/03/85 STATUS: PRELIMINARY

PROJECT NUMBER 84936300
FIELD GROUP: 3612A
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

PARAMETERS	STORET # METHOD #	3129A 508918	3129B 508919	3129C 508920	3129D 508921	3129E 508922	3130A 508924	3130B 508925	3131A 508930	3131B 508931	3132A 508936
DATE		05/06/85	05/06/85	05/06/85	05/06/85	05/07/85	05/06/85	05/06/85	05/06/85	05/06/85	05/06/85
TIME		1437	1442	1504	1546	618	1356	1404	1139	1154	931
DIMP (UG/G-DRY)	98645 0	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
DICHLORVOS (UG/G-DRY)	98646 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
HEXCLCYPENDI (UG/G-DRY)	98647 0	<1.00	<1.00	<1.00	<1.00	<0.869	<1.00	<1.00	<1.00	<1.00	<1.00
MALATHION (UG/G-DRY)	98648 0	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600	<0.600
ISODRIN (UG/G-DRY)	98649 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
1,4 DITHIANE (UG/G-DRY)	98650 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
DICYCLOPENTADIENE (UG/G-DRY)	98651 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
DBCP(NEMAGON) (UG/G-DRY)	98652 0	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
P-CLPHENYLMETHYSULFIDE(UG/G-D)	98653 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
P-CLPHENYLMETHYSULFONE(UG/G-D)	98654 0	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400	<0.400
ATRAZINE (UG/G-DRY)	98655 0	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700
SUPONA (UG/G-DRY)	98656 0	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500	<0.500
DMMP (UG/G-DRY)	98657 0	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
ETYLPARATHION (UG/G-DRY)	98658 0	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700	<0.700
CARBON TETRACHLORIDE (UG/G-DRY)	98660 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
CHLOROBENZENE (UG/G-DRY)	98661 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
CHLOROFORM (UG/G-DRY)	98682 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
1,1-DICHLOROETHANE (UG/G-DRY)	98683 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
1,2-DICHLOROETHANE (UG/G-DRY)	98684 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
BICYCLOHEPTADIENE (UG/G-DRY)	98686 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA

ENVIRONMENTAL SCIENCE & ENGINEERING   12/03/85   STATUS: PRELIMINARY

PROJECT NUMBER 84936300
FIELD GROUP: 3612A
PARAMETERS: ALL   SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

PARAMETERS	STORET # / METHOD #	3129A 508913	3129B 508919	3129C 508920	3129D 508921	3129E 508922	3130A 508924	3130B 508925	3131A 508930	3131B 508931	3132A 508936
DATE		05/06/85	05/06/85	05/06/85	05/06/85	05/07/85	05/06/85	05/06/85	05/06/85	05/06/85	05/06/85
TIME		1437	1442	1504	1546	818	1356	1404	1139	1154	931
TRANS-1,2-DICHLOROETHENE (UG/G-D	93687 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
ETHYLBENZENE (UG/G-DRY)	93688 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
METHYLENE CHLORIDE (UG/G-DRY)	93689 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
TETRACHLOROETHENE (UG/G-DRY)	93690 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
TOLUENE (UG/G-DRY)	93691 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
1,1,1-TRICHLOROETHANE (UG/G-D)	93692 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
1,1,2-TRICHLOROETHANE (UG/G-D)	93693 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
TRICHLOROETHENE (UG/G-DRY)	93694 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
M-XYLENE (UG/G-DRY)	93695 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
MIBK (UG/G-DRY)	93696 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
DMDS (UG/G-DRY)	93697 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
BENZENE (UG/G-DRY)	93699 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
O-AND/OR P-XYLENE (UG/G-DRY)	93700 0	NA	NA	NA	NA	<0.500	NA	NA	NA	NA	NA
PCPMSO2 UG/G-DRY	93703 0	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
COORDINATE,N/S(STP)	93392 0	180830	180830	180830	180830	180830	180710	180710	180948	180948	180769
COORDINATE,E/W(STP)	93393 0	2188111	2188111	2188111	2188111	2188111	2188154	2188154	2187811	2187811	2187751
UNK620 (UG/G)	99074 0	2.13				0.951					
UNK621 (UG/G)	99075 0	0.453		0.279							
UNK633 (UG/G)	99065 0	0.652					0.170		0.224		
UNK637 (UG/G)	99089 0	0.569									

ENVIRONMENTAL SCIENCE & ENGINEERING 12/03/85 STATUS: PRELIMINARY

PROJECT NUMBER: [illegible]36300
FIELD GROUP: 3612A
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

		SAMPLE NUMBERS									
PARAMETERS	STORET # / METHOD #	3129A 508918	3129B 508919	3129C 508920	3129D 508921	3129E 508922	3130A 508924	3130B 508925	3131A 508930	3131B 508931	3132A 508936
DATE		05/06/85	05/06/85	05/06/85	05/06/85	05/07/85	05/06/85	05/06/85	05/06/85	05/06/85	05/06/85
TIME		1437	1442	1504	1546	818	1356	1404	1139	1154	931
UNK542 (UG/G)	00108 0	0.435									
UNK558 (UG/G)	00098 0		0.071								
UNK559 (UG/G)	00099 0		0.055								
UNK619 (UG/G)	00105 0		0.286	1.63	0.345		0.333	0.282	0.637	0.222	0.171
UNK635 (UG/G)	00087 0		0.194								
UNK629 (UG/G)	00082 0			2.06		1.23	0.738		1.89		
UNK608 (UG/G)	00065 0				0.138		0.416		0.465		
UNK614 (UG/G)	00070 0				0.506					0.462	
UNK638 (UG/G)	00106 0								0.221		
UNK524 (UG/G)	00015 0										

ENVIRONMENTAL SCIENCE & ENGINEERING 12/03/85 STATUS: PRELIMINARY

PROJECT NUMBER 34756300
FIELD GROUP: 3012A
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

SAMPLE NUMBERS

PARAMETERS	STORET #	METHOD #	3132B 508937	3132C 508938	3132D 508939	BLK 508980	BLK 508981
DATE			05/06/85	05/06/85	05/06/85	05/06/85	05/06/85
TIME			939	1000	1022	0	0
SAMPLE TYPE	71999	0	SO	SO	SO	SO	SO
SAMPLE DEPTH(CM)	99758	0	122	274	427	0	0
SITE TYPE 1	99759	0	BORE	BORE	BORE	QCMB	QCMB
INSTALLATION CODE	99720	0	RK	RK	RK	RK	RK
SAMPLING TECHNIQUE	72005	0	S	S	S	G	G
MOISTURE(%-ET WT)	70320	0	1.4	16.2	14.8	2.6	2.6
CADMIUM,SED (UG/G-DRY)	1028	0	<0.9	<0.9	<0.9	<0.9	NA
CR,SOIL (UG/G-DRY)	99584	0	10	26	27	13	NA
COPPER,SED (UG/G-DRY)	1043	0	7	47	24	10	NA
LEAD,SED (UG/G-DRY)	1052	0	<17	20	20	16	NA
ZINC,SED (UG/G-DRY)	1093	0	35	58	78	39	NA
ARSENIC,SED (UG/G-DRY)	1003	0	<4.7	6.9	<4.7	<4.7	NA
MERCURY,SED (UG/G-DRY)	71921	0	<0.05	<0.05	<0.05	<0.05	NA
ALDRIN,SED (UG/G-DRY)	93356	0	<0.900	<0.900	<0.900	<0.900	NA
DIELDRIN(UG/G-DRY)	98365	0	<0.300	<0.300	<0.300	<0.300	NA
DDT,PP'(UG/G-DRY)	98364	0	<0.400	<0.400	<0.400	<0.400	NA
ENDRIN (UG/G-DRY)	98369	0	<0.700	<0.700	<0.700	<0.700	NA
CHLORDANE,SED(UG/G-DRY)	98361	0	<1.00	<1.00	<1.00	<1.00	NA
DDE,PP'(UG/G-DRY)	98363	0	<0.300	<0.300	<0.300	<0.300	NA
1,4 OXATHIANE (UG/G-DRY)	98644	0	<0.300	<0.300	<0.300	<0.300	NA

ENVIRONMENTAL SCIENCE & ENGINEERING 12/03/85 STATUS: PRELIMINARY

PROJECT NUMBER 34780300
FIELD GROUP: 36.2A
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

SAMPLE NUMBERS

PARAMETERS	STORET # / METHOD #	31328 508937	3132C 508935	3132D 508939	BLK 508960	BLK 508961
DATE		05/06/85	05/06/85	05/06/85	05/06/85	05/06/85
TIME		939	1000	1022	0	0
DIMP (UG/G-DRY)	98645 0	<0.500	<0.500	<0.500	<0.500	NA
DICHLORVOS (UG/G-DRY)	98646 0	<0.300	<0.300	<0.300	<0.300	NA
HEXCLCYPENDI (UG/G-DRY)	98647 0	<1.00	<1.00	<1.00	<1.00	NA
MALATHION (UG/G-DRY)	98648 0	<0.600	<0.600	<0.600	<0.600	NA
ISODRIN (UG/G-DRY)	98649 0	<0.300	<0.300	<0.300	<0.300	NA
1,4 DITHIANE (UG/G-DRY)	98650 0	<0.300	<0.300	<0.300	<0.300	NA
DICYCLOPENTADIENE (UG/G-DRY)	98651 0	<0.300	<0.300	<0.300	<0.300	NA
DBCP(NEMAGON) (UG/G-DRY)	98652 0	<0.005	<0.005	<0.005	<0.005	<0.005
P-CLPHENYLMETHYLSULFIDE(UG/G-D)	98653 0	<0.300	<0.300	<0.300	<0.300	NA
P-CLPHENYLMETHYLSULFONE(UG/G-D)	98654 0	<0.400	<0.400	<0.400	<0.400	NA
ATRAZINE (UG/G-DRY)	98655 0	<0.700	<0.700	<0.700	<0.700	NA
SUPONA (UG/G-DRY)	98656 0	<0.500	<0.500	<0.500	<0.500	NA
DMMP (UG/G-DRY)	98657 0	<2.00	<2.00	<2.00	<2.00	NA
ETY*PARATHION (UG/G-DRY)	98658 0	<0.700	<0.700	<0.700	<0.700	NA
CARBON TETRACHLORIDE (UG/G-DRY)	98680 0	NA	NA	<0.500	<0.300	NA
CHLOROBENZENE (UG/G-DRY)	98681 0	NA	NA	<0.500	<0.300	NA
CHLOROFORM (UG/G-DRY)	98682 0	NA	NA	<0.500	0.981	NA
1,1-DICHLOROETHANE (UG/G-DRY)	98683 0	NA	NA	<0.500	<0.300	NA
1,2-DICHLOROETHANE (UG/G-DRY)	98684 0	NA	NA	<0.500	<0.300	NA
BICYCLOHEPTADIENE (UG/G-DRY)	98686 0	NA	NA	<0.500	<0.300	NA

ENVIRONMENTAL SCIENCE & ENGINEERING 12/03/85 STATUS: PRELIMINARY

PROJECT NUMBER 0-[illegible]300
FIELD GROUP: 3612A
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

PARAMETERS	STORET # / METHOD #	31328 508937	3132C 508938	3132D 508939	BLK 508980	BLK 508981
DATE		05/06/85	05/06/85	05/06/85	05/06/85	05/06/85
TIME		939	1030	1022	0	0
TRANS-1,2-[illegible] (UG/G-D[illegible])	99687 0	NA	NA	<0.500	<0.300	NA
ETHYLBENZENE (UG/G-DRY)	99688 0	NA	NA	<0.500	<0.300	NA
METHYLENE CHLORIDE (UG/G-DRY)	99689 0	NA	NA	<0.500	0.831	NA
TETRACHLOROETHENE (UG/G-DRY)	99690 0	NA	NA	<0.500	<0.300	NA
TOLUENE (UG/G-DRY)	99691 0	NA	NA	<0.500	<0.300	NA
1,1,1-TRICHLOROETHANE (UG/G-D)	99692 0	NA	NA	<0.500	0.398	NA
1,1,2-TRICHLOROETHANE (UG/G-D)	99693 0	NA	NA	<0.500	<0.300	NA
TRICHLOROETHENE (UG/G-DRY)	99694 0	NA	NA	<0.500	<0.300	NA
M-XYLENE (UG/G-DRY)	99695 0	NA	NA	<0.500	<0.300	NA
MIBK (UG/G-DRY)	99696 0	NA	NA	<0.500	<0.500	NA
DMDS (UG/G-DRY)	99697 0	NA	NA	<0.500	<0.300	NA
BENZENE (UG/G-DRY)	99699 0	NA	NA	<0.500	<0.300	NA
O-AND/OR P-XYLENE (UG/G-DRY)	99700 0	NA	NA	<0.500	<0.500	NA
PCPMSO2 (UG/G-DRY	99703 0	<0.300	<0.300	<0.300	<0.300	NA
COORDINATE, N/S(FEET)	99392 0	180769	180769	180769	NA	NA
COORDINATE, E/W(FEET)	99393 0	2187751	2187751	2187751	NA	NA
UNK620 (UG/G)	99674 0		0.900			
UNK621 (UG/G)	99675 0		0.245			
UNK633 (UG/G)	99655 0					
UNK637 (UG/G)	99669 0					

ENVIRONMENTAL SCIENCE & ENGINEERING 12/03/85 STATUS: PRELIMINARY

PROJECT NUMBER 8.036300
FIELD GROUP: 36120
PARAMETERS: ALL SAMPLES: ALL

PROJECT NAME SECTION 36 RMA
PROJECT MANAGER: BILL FRASER
FIELD GROUP LEADER: GEISZLER/BERGDOLL

SAMPLE NUMBERS

PARAMETER	STORET # / METHOD #	31323 508937	3132C 508938	3132D 508939	BLK 508960	BLK 508981
DATE		05/06/85	05/06/85	05/06/85	05/06/85	05/06/85
TIME		939	1000	1022	0	0
UNK642 (UG/G)	00108 0					
UNK556 (UG/G)	00098 0					
UNK559 (UG/G)	00099 0					
UNK619 (UG/G)	00105 0	0.272		0.310		
UNK635 (UG/G)	00087 0					
UNK629 (UG/G)	00082 0		1.13			
UNK502 (UG/G)	00065 0					
UNK614 (UG/G)	00070 0		0.434	0.907		
UNK630 (UG/G)	00106 0					
UNK524 (UG/G)	00015 0					

APPENDIX 36-12-C
COMMENTS AND RESPONSES

COLORADO DEPARTMENT OF HEALTH

Richard D. Lamm
Governor

Thomas M. Vernon, M.D.
Executive Director

May 7, 1986

Mr. Donald Campbell
Office of the Program Manager
RMA Contamination Cleanup
Department of the Army
Aberdeen Proving Ground
Maryland, 21010-5401

Dear Mr. Campbell:

Enclosed are our comments on the Phase II, Section 36, Draft Final Source Report, 36-5, 36-8, 36-10, 36-11, 36-20, 36-21, and 36-22. This document includes a very brief discussion of the general approach for conducting Phase II investigations and a proposal for Phase II "indicator levels" for all future source area investigations.

As we stated in our preliminary comments transmitted to you on April 2, 1986, we do not concur with the proposed Phase II approach and specifically with the proposed inorganic indicator levels. It was not at all clear in the report how the indicator levels for the metals were determined. At the April 22, 1986 MOA Onpost Task Group Meeting, Mr. Kevin Blose stated that the proposals for the Phase II approach and indicator levels were generated together by the Army and the U.S. EPA. We were told that this occurred at "numerous meetings in the past several months" between the Army Staff, the Army's remedial contractors and Mr. Jim Baker, the EPA Region VIII toxicologist. Since we were not present at any of these meetings, we are formally requesting that you provide to us the minutes and any handouts from each of the meetings so that we may better understand the reasoning behind the Army and EPA's Phase II proposals.

Thank you for your consideration in this matter.

Sincerely,

Tom Looby

Thomas P. Looby
Remedial Programs Director

TPL:CS/ras

cc: Howard Kenison, Colorado Attorney General Office
Bob Duprey, U. S. EPA, Region VIII
Bob Lundahl, Shell Chemical Co.

4210 EAST 11TH AVENUE DENVER COLORADO 80220 PHONE (303) 320-8333

REVIEW COMMENTS ON THE PHASE II., SECTION 36 DRAFT FINAL SOURCE REPORT, 36-5, 36-8, 36-10, 36-11, 36-20, 36-21 AND 36-22, FEBRUARY 1986

GENERAL COMMENTS

1. The "Executive Summary" section is not an accurate heading for this portion of the report. According to the Onpost Task Group meeting held on April 22, 1986, the section is actually an abbreviated discussion of the Army and EPA's proposal for determining representative background levels for metals at RMA and Phase II "indicator levels" for contaminants analyzed in the Phase I unsaturated soils sampling program. For organic compounds, the background and indicator levels proposed are the same as the analytical method detection limit. For the metals, it is not clear whether there was a statistical or scientific basis used to establish the indicator levels.

   We recommend that the entire Executive Summary Section should be removed from this document and be rewritten as a separate document. The separate report would be a detailed compilation and evaluation of as much of the "uncontaminated area" soils data as exists at the time the draft is prepared. The final report would include all the Phase I soils data for the known "uncontaminated areas" of RMA. The report must include a thorough statistical analysis of all the soils data collected to document what constitutes the "background" or naturally occurring levels for all inorganic contaminants examined in the Phase I program.

   The executive summary defines an indicator level as "a concentration or range of concentrations for each potential contaminant above which that contaminant approaches levels considered to be above natural background variability. These indicator levels are not to be considered action levels as they are not based on toxicity." Using this definition of an indicator level, the report would then identify the concentration or range of concentrations where a contaminant approaches levels considered to be above natural background variability. That variability within the data base can be expressed as the standard deviation (sigma). The indicator levels for inorganics would then be established based on multiples of sigma. If a concentration of a potential contaminant exceeds the calculated background level plus two times sigma, then you are 95% confident that the level found in the soil sample is "above natural background variability". We propose that at a minimum, all Phase I soils data that exceed the 95% confidence level should be evaluated in the Phase II investigations. Some substantial justification would have to be provided to eliminate that boring from the Phase II program. If indicator ranges for inorganic metals are desired, we would propose using the 90% confidence level as the lower limit when Phase II investigations should be considered.

   The Phase I "uncontaminated area" soils data collected from the four most contaminated sections on the Arsenal (36, 26, 1 and 2) must not be used in the assessment of background concentrations for metals. The probability that contamination has migrated to these areas from windblown deposits, contaminated surface water or ground water is very high. The report should also discuss the objectives of the Phase II program, the changes in the sampling methodology and analytic procedures, and other procedural changes from the Phase I program.

2. We do not concur with all the indicator levels presently proposed by the Army and EPA in the Phase II report. The levels proposed in the Executive Summary for metals need substantially greater justification than one paragraph per inorganic metal as offered in the summary. Until the above described analysis to establish statistically and scientifically based indicator levels can be completed, we propose that the following indicator levels be utilized in all Phase II investigations.

ANALYTE AND RMA DET. LIM.	RMA PROPOSED INDICATOR LEVEL	COMMENT	CDH PROPOSED INDICATOR LEVEL
All Organic Compounds	Method Detection limit		Method Detection limit of
Arsenic 4.7 ppm	10 - 15 ppm	None detected (ND) in 87% of the 258 Phase I samples collected. ND in 97% of all Phase I samples collected outside Sec. 36.	Method Detection limit of 4.7 ppm
Cadmium .5 ppm - .9 ppm	2-5 ppm	ND in 98% of the Phase I samples at .5 to .9 ppm	Method Detection limit of .5 -.9 ppm.
Chromium 7ppm	30-50 ppm	ND in 33% of Phase I samples at 7 ppm. Actual mean was approx. 10 ppm. Highest level found in 258 Phase I samples 24 ppm.	20 ppm
Copper 5 ppm	20-50 ppm	ND in 25% of the Phase I samples 70% of all samples show 10 ppm or less. Highest level found in 258 samples was 24 ppm. A 30 ppm range is not justified	20 ppm
Mercury .05 ppm	.1-.2 ppm	ND in 93% of all Phase I samples ND in 99% of all samples collected outside Sec. 36.	Method detection limit of .05 ppm

Lead 16 ppm	30-75 ppm	ND in 60% of all Phase I samples. 75% of samples had less than 20 ppm. Highest concentration found in all Phase I Samples was 44 ppm.	25 ppm
Zinc 10 ppm	80-100 ppm	ND in 7% of Phase I samples at 10 ppm Mean concentration found approximately 36 ppm. Highest concentration in 258 Phase I samples was 65 ppm.	50 ppm

3. The Phase II monitoring program must incorporate contaminant transport mechanisms into the sample collection scheme. In areas where windblown contamination is suspected, samples of the upper 2-4 inches of soils would be collected. Phase II investigations of source areas must extend into the uppermost saturated zone to evaluate if the source area is contributing to contamination found in the saturated zone.

   The Phase II Remedial Investigation program within the presumed uncontaminated portions of RMA must investigate the primary contaminant transport pathway to confirm that no active source areas remain undetected. Some soil bores in the "uncontaminated" areas must extend into the uppermost saturated zone except in areas where detailed definition of the chemical quality of the uppermost groundwater system exists. Volatile organics contaminants were eliminated from analysis in all Phase I uncontaminated area samples due to the compositing procedure which we did not agree was appropriate sample collection method. All Phase II investigations of the uncontaminated areas must include the analysis of volatiles in the deepest interval at or within the saturated zone.

4. For all future source reports, related or adjacent source areas should be compiled into a single volume or provided for review in several volumes simultaneously. This first Phase II report often referred to data collected from source areas that were not included in this volume. There were several instances when the Army was using data to support decisions to eliminate sources or alter source boundaries without providing that data to us. Without the data we are unable to concur with the Army's recommendations and this may eventually delay Phase II implementation.

**FINAL RESPONSE TO SPECIFIC COMMENTS OF
COLORADO DEPARTMENT OF HEALTH
TASK 1, DRAFT FINAL PHASE I REPORT
SITE 36-12: PITS/TRENCHES**

General comments made in the cover letter by Colorado Department of Health were discussed at the MOA meeting on June 3 and 4, 1986. A final response to these comments is included within the minutes of the MOA meeting. The following responses address the preceding specific comments from Colorado Department of Health on the Final Site 36-12 Report.

Comment 1:
P. 36-12-2 Boring location for 3010 needs to be corrected.

Response: Boring location for 3010 has been corrected.

Comment 2:
P. 36-12-12 Boring 3127 had arsenic at 10 ug/g in A interval; Boring 3131 had mercury at 0.1 ug/g in A interval. These need to be indicated.

Response: The figures only showed values above the lower indicator level at that time. These results have been added to the figure.

Comment 3:
P. 36-12-16 What efforts were made to assure that the Phase I boring locations actually penetrated the trenches and were not located outside them.

Response: Please see the Introduction to the Contamination Assessment Reports, the Task 1 Technical Plan, and Section 2.0 of this text regarding the rationale for boring placement. According to historical evidence, aerial photograph interpretation, personnel interviews, and field observations, trenches were never dug at this site.

Comment 4:
P. 36-12-19 Given the results in Figure 31-12-3, justification for no Phase II work needs additional clarification.

Response: Please see p. 36-12-9 for a site history update and p. 36-12-21 for an explanation of bedrock high effects on metals levels. Shallow mercury contamination will be further investigated under the windblown contamination study for nonsource areas in Section 36.

Shell Oil Company

One Shell Plaza
P.O. Box 4320
Houston, Texas 77210

April 7, 1986

USATHAMA
Office of the Program Manager
Rocky Mountain Arsenal Contamination Cleanup
ATTN: AMXRM-EE: Chief: Mr. Donald L. Campbell
Building E4585
Aberdeen Proving Ground, MD 21010-5401

Dear Mr. Campbell:

We submit herewith Shell's comments on the draft final copies of Contamination Assessment Reports on Section 36, sources 36-5, 36-8, 36-10, 36-11, 36-12, 36-20, 36-21, and 36-22, February 1986.

In view of the limited time available for review, Shell may have additional comments at a later date. Also, since as indicated in your March 11, 1986 cover letter, this first group of reports represents relatively straightforward contamination results and uncomplicated Phase II sampling design, it may not expose substantive issues which may arise in the later more complex source assessments. For this reason also we reserve the right to make additional comments at a later date.

General comments which apply to the methodology and data presentation of all reports are provided below. Comments on specific sources are attached.

Our most serious concern with your assessment approach is with the derivation of background levels ("Indicator Levels") as described in the Executive Summary.

- For all seven of the trace metals, the indicator levels selected are greater than the facts presented can support. This is due partly to the use of national and regional background statistics (literature sources) in guiding the selection of the indicator levels. Comparison of local background data (bulk soil sample and soil from "uncontaminated" areas) clearly shows that the literature statistics are not representative of the RMA environment, i.e., they indicate higher background levels.

- Some of the soil analyses of "uncontaminated" areas (Table 4) used in guiding the selection of indicator levels can be expected to include a contaminant component in addition to natural background.

BIHM8609206

This may be especially true for mercury and arsenic based on Section 36 Phase I data which indicates frequent occurrences of these metals at shallow levels. This would tend to increase apparent natural background levels.

- The highest measurements (upper 20%) for each metal in the "uncontaminated" soil samples appear to have keyed the lower bound of the selected indicator level. The upper bounds (excepting zinc) range from a factor of 1.6 to 2.5 of the lower bound. This results in too broad a range in which proposed decisions will be made on the Phase II investigation.

- Shell's proposals for indicator levels are developed in comments under the Executive Summary section of the attached comments.

A second concern relates to the presentation (or lack thereof) of data and other information. Certain features of the presentation, listed below, could cause misinterpretation of the data or misdirection of subsequent work efforts.

- Sampling intervals in each report (e.g., Table 36-5-1) list the planned intervals in the Phase I Technical Plan but the actual depth of the interval was frequently changed in the field (usually because the water table was encountered). Actual depth of sampling should be shown in the reports for each sample.

- Each report includes a table of most recent analyses of groundwater under or near the source area (e.g., Table 36-5-5). Many of these analyses are quite old, up to 8 years, and therefore highly questionable as to interpretive value. Also, since groundwater contamination at any point frequently reflects contaminants up dip of the area, it is difficult to see how inclusion of groundwater analysis can provide insight to contamination on a localized basis. Groundwater data should not be included unless inferences can reasonably be made from it.

- Soil samples taken near the water table may reflect contaminants from the underlying groundwater (by volatilization or level fluctuation) as opposed to contamination from the surface. This should be suspected especially when volatiles are found at this level but not at shallower levels. See for example boring 3136 in Source 36-5. A designator should be used when groundwater contamination is possible.

- Modifications to source area boundaries from the Phase I Technical Plan occur frequently in this set of reports, e.g., Source 36-5 and 36-11. The modifications should be described in the text and reasons stated.

- In designing Section 36 Phase II plans, several of the source areas in these reports are redistributed and consolidated with other source areas. This creates multiple source areas for Phase II study but the title of the expanded sources do not reflect this. For example, borings are assigned to Source 36-20 (Chemical Sewer) which are unlikely to have been impacted by the chemical sewer because of lateral distance from it. To avoid misinterpretation of data, adjustments should be made to titles in these instances.

Finally, we would like to comment regarding the Army's screening method whereby the data generated by all samples analyzed for semi-volatile and volatile compounds by GC/MS be examined to identify the unknown present. The issue of identification of unknowns is not a new issue and has been the subject of numerous communications in recent months, in particular with regard to possible degradation compounds from Army surety agents. Shell has provided the Army with a list of compounds which have a high probability of being in the environment. Unfortunately, the screening techniques utilized by the Army have a low probability of detecting most of the compounds specified by Shell. Most of these compounds would not get through the gas chromatographic columns and would require derivatization to be amenable to the specified analytical techniques. This may account for the fact that, basis the Assessment Reports released thus far, unknowns have not been found, except for naturally occurring organic compounds or impurities introduced during extraction. We recognize that the Army has plans underway to supplement Phase II analytical efforts with several specific target compounds and possible addition of methods for organo-mercury and organo-arsenic compounds. This is a step in the right direction.

We look forward to discussing these comments at a forthcoming On-Post MOA Task Group meeting.

Very truly yours,

C.K. Hahn

C. K. Hahn, Manager
Denver Site Project
Manufacturing & Technical

RDL:ajg

Attachment

cc: (w/attachment)
USATHAMA
Office of the Program Manager
Rocky Mountain Arsenal Contamination Cleanup
ATTN: AMXRM-EE: Mr. Kevin T. Blose
Aberdeen Proving Ground, MD 21010-5401

Mr. Thomas Bick
Land & Natural Resources Division
U.S. Department of Justice
P.O. Box 7415
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Major Robert J. Boonstoppel
Headquarters - Department of the Army
ATTN: DAJA-LTS
Washington, DC 20313-2210

FINAL RESPONSE TO SPECIFIC COMMENTS OF
SHELL OIL COMPANY ON
TASK 1, DRAFT FINAL PHASE I REPORT
SITE 36-12: PITS/TRENCHES

General comments made in the cover letter by Shell Oil Company were discussed at the MOA meeting on June 3 and 4, 1986. A final response to these comments is included within the minutes of the MOA meeting. The following responses address the preceding specific comments from Shell Oil Company on the Final Site 36-12 Report.

Comment 1: P. 36-12-19 last paragraph	Agree that follow-up studies on shallow mercury contamination should be conducted.
Response:	An additional area-wide investigation of mercury contamination will be conducted under the Section 36 Nonsource Area windblown contamination study.